On a new Gymnoblastic Hydroid *(Ichthyocodium sarcotretis)* epizoic on a new Parasitic Copepod *(Sarcotretes scopeli)* infesting *Scopelus glacialis* Rhdt.

By

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(With Pl. I and II.)

About two years ago one of my pupils, Mr. Blegvad — now Cand. mag. — handed over to me a specimen of *Scopelus glacialis* with a most remarkable parasite, asking me what the latter might likely be. The fish with the strange guest had been captured in August or September 1906 in the depth of the Atlantic off the S. W. coast of Ireland by the Danish steamer "Thor", on an investigation cruise in which Mr. Blegvad took part as assistant naturalist. I was not able to answer the question immediately and laid the specimen aside for closer examination later. This examination I have only recently found time to make. The parasite (Pl. I, Fig. 1) at first sight appears made up of a stem and a large number of branchlets. The stem is stout, when viewed with a strong lens densely striated transversely; it narrows somewhat abruptly into a short slender stalk inserted into the body of the fish. Both sides and the face looking towards the fish are covered with a great number of quite soft structures resembling papillæ; the whole thing bears a superficial likeness to an "*Eolis*". At first I thought it might be a *Pennella*, but the soft and irregularly grouped papillæ did not show any great likeness to the firmly cuticularized, branched and symmetrically arranged appendages of a *Pennella*. Closer examination of some of the larger and stouter "papillæ", which had fallen off from the sides of the stem, revealed the structure of Medusæ, and a slender "papilla" from the inner face of the parasite turned out to be a Polype with medusæ-buds in various stages of development. Thus the question evidently was of some colony of Hydroids; but the stem soon turned out to be, not a part of a Hydroid, but of a Parasitic Copepod, belonging to the family of *Lernæidæ.* Without destroying the beautiful specimen given by Mr. Blegvad, I reached this conclusion from a thorough search for parasites in the rich collection of *Scopelini* from the Atlantic, which our Museum had obtained from the steamer "Thor". More than two thousand specimens of *Scopelini* were examined for this purpose; I succeeded in finding 6 other specimens of the "combined parasite"; some of these had egg-strings — or remnants of egg-strings — still adhering, and thus did not leave any doubt about the nature of the "stem". The new material did not contain any specimen so richly developed as the first one, but on the other hand it yielded developmental stages both of the Hydroid and of the Parasitic Copepod. Especially the latter seem to me of some value as a supplement to what has been known hitherto of the metamorphosis of some other *Lernæidæ (Lernæa, Pennella).*

My material, further, shows that the association of the Hydroid with the Parasitic Copepod is not a "necessary" one, in so far that the parasitic Crustacean may be found without the Hydroid; on the other hand, I never found the Hydroid without the Copepod, though the fact is not unknown that some Hydroids grow directly on the body of fishes (2; 7 a, b; 13; 20 a; 8, 9).

That the association is not an accidental one seems to be proved by the fact that a proportionally large number of the Parasitic Copepod carry the Hydroid. 22 specimens of the Copepod in its final form, inserted into the body of the fish, were found; but of these 8 are very young and the part protruding outside the fish is so small, that it could not be expected beforehand, that any Hydroid should attach itself upon it; of the remaining 14 large and adult specimens just half the number bear the Hydroid.

The Copepod, consequently also the association, appears to be bound to a single species of host, *Scopelus glacialis* Rhdt.; and only on the same fish have been found all the developmental stages which precede that of insertion into the body of the host. As already mentioned I have examined a great number of *Scopelini* and allied forms from the Atlantic, between 2 and 3 thousand specimens, but I have never found this parasite — nor any other Parasitic Copepod — on other species of the genus *Scopelus* (taken in its widest sense as comprising *Rhinoscopelus*, *Myctophum* etc.) nor on species of genera like *Cyclothone*, *Argyropelecus*, *Maurolicus*, *Stomias* etc., which were captured by the "Thor" often in numbers together with *Scop. glacialis* on the same stations. The parasite in question has only been taken by the "Thor" in the part of the Atlantic lying between 48° 15′ Lat. N. and 65° Lat. N., and between 4° 33′ Long. W. and 28° 10′ Long. W., always in a considerable depth — from 100 to 600 met. below the surface. By the ship "Tjalfe", on a surveying expedition to the Greenland waters under supervision of Mr. Ad. Jensen, only a single (young) specimen was captured farther west, sc. at 48° 26′ Long. W., 60° 07′ Lat. N. In the Davis-Strait it seems not to occur; among some 330 specimens of *Scop. glacialis* collected by the "Tjalfe" W. of Greenland, between ca. 63° and 71° Lat. N., none were found infested. In collections made by the "Thor" in the Atlantic south of the above named boundary I did not find the parasite; and it is likewise wanting on the numerous *Scop. glacialis* collected by the "Thor" in the Mediterranean. In the latter this fish and — less often — two other species of *Scopelus* were found infested with an allied Parasitic Copepod *Peroderma bellottii;* but on this I never found any Hydroid.

That our parasite is by no means of frequent occurrence seems to be proved by the fact that to yield the 22 above-named specimens more than 1800 specimens of *Scopelus glacialis* had to be examined.

For the sake of completeness all the localities for the material examined are given below.

1. The association of the Parasitic Copepod with the Hydroid.

"Thor"'s Station No.	Lat. N.	Long. W.	Depth of the Station in Metres	Depth of the Capture in Metres	Date
286.	61° 49′	14° 11′	1000	400	2/9 04.
164.	61° 20′	11° 00′	1300	150	29/8 05.
124.	61° 04′	4° 33′	1075	500	23/7 05.
89.	55° 45′	9° 35′	1600	100	23/6 06.
185.	51° 56′	11° 55′	350—640	150—450	8/9 06.
93.	49° 23′	12° 20′	ca. 1300	100	5/6 05.
?	S. W. of Ireland		?	?	? 06.

2. The Parasitic Copepod, without the Hydroid.

"Thor"'s Station No.	Lat. N.	Long. W.	Depth of the Station in Metres	Depth of the Capture in Metres	Date
152.	65° 00′	28° 10′	1240	400	19/6 04.
286 (2 spec.).	61° 49′	14° 11′	1000	400	2/9 04.
124.	61° 04′	4° 33′	1075	500	23/7 05.
89.	55° 09′	9° 35′	1600	100	23/6 06.
182.	50° 11′	12° 05′	2200	150	4/9 06.
76 (3 spec.).	49° 27′	13° 33′	2600	400	11/6 06.
93.	49° 23′	12° 20′	ca. 1300	100	5/6 05.
88 (2 spec.).	48° 09′	8° 30′	600	150	20/6 05.
87.	48° 05′	8° 29′	2000	150	20/6 05.
"Tjalfe"'s St.No.					
321.	60° 07′	48° 26′	? (but more than 2000)	300	3/5 09.

3. Stages of Development of the Parasitic Copepod (Cyclops-stage and Pupæ)

"Thor"'s Station No.	Lat. N.	Long. W.	Depth of the Station in Metres	Depth of the Capture in Metres	Date
	A. (Cyclops-stage).				
80.	51° 34′	11° 50′	1140	500	16/6 06.
93 (2 spec.).	49° 23′	12° 20′	ca. 1300	100	5/6 05.
	B. 1st Pupal Stage.				
285.	62° 49′	18° 46′	1000	250	1/9 04.
80.	51° 34′	11° 50′	1140	500	16/6 06.
93.	49° 23′	12° 20′	ca. 1300	100	5/6 05.
63.	48° 09′	8° 36′	?	?	?
	C. 2nd Pupal Stage.				
88.	55° 05′	12° 20′	2000	100	22/6 06.
177.	49° 30′	11° 38′	550	150	1/9 06.
76 (4 spec.).	49° 27′	13° 33′	2600	400	11/6 06.
178.	48° 04′	12° 40′	4000	500	2/9 06.

"Thor"'s Station No.	Lat. N.	Long. W.	Depth of the Station in Metres	Depth of the Capture in Metres	Date
	D. 3rd Pupal Stage.				
152.	65° 00′	28° 10′	1240	500	19/6 04.
285.	62° 49′	18° 46′	1000	?	1/9 04.
88.	55° 05′	12° 20′	2000	100	22/6 06.
80.	51° 34′	11° 50′	1140	500	16/6 06.
175.	51° 11′	11° 41′	575	100	30/8 06.
76.	49° 27′	13° 33′	2600	400	11/6 06.
93 (2 spec.)	49° 23′	12° 20′	ca. 1300	100	5/6 05.
	E, 4th Pupal Stage.				
230.	63° 10′	7° 31′	1090	600	3/8 04.
88.	55° 05′	12° 20′	2000	100	22/6 06.
76 (3 spec.).	49° 27′	13° 33′	2600	400	11/6 06.
93 (7 spec.).	49° 23′	12° 20′	ca. 1300	100	5/6 05.

I. The Parasitic Copepod.

1. The adult female (Pl. I, Figs. 7—10).

The female parasite is sunk into the body of the fish, leaving outside of the host its posterior part, which is larger or smaller according to the age and development of the parasite. The infested *Scopelus glacialis* are from 20 to 57 mm. in length, mostly less than 30 mm. In most cases the parasite is seen projecting from the dorsal part of the fish (i. e. above the lateral line), most often in front of the dorsal fin (of the 22 specimens 16 penetrate dorsally, of these again 13 in front of the dorsal fin; 6 are attached ventrally). The greater number is found on the right side (11 on the right, 7 on the left side, 4 just in the middle line). With its anterior part it penetrates through the body wall to the intestines of the host; the posterior, visible part is largest and stoutest in egg-bearing individuals, but the length of the hidden, internal part does not always correspond to that of the external: to reach the intestines the individuals which protrude near the dorsal middle line, especially those fixed behind the dorsal fin, have a longer way to penetrate than those attached ventrally. In egg-bearing females the external part is generally club-shaped; near the surface of the fish it narrows more or less abruptly into a slender stalk, sunk through a kind of vault of the skin deeper into the tissues of the host; in length it varies from 3 to 7 mm., with a largest diameter of from 1,5 to 2 mm. The position of the genital openings, carrying the egg-strings, shows that the ventral side of the parasite looks towards the surface of the fish. The egg-strings seem rather variable in length: in one specimen, the external part of which measured 4 mm. in length, 1,5 mm. in breadth, they were only 7 mm., although quite complete; in another specimen, where the external part measures 7 mm. in length, the egg-strings — though deprived of their outer ends — are 22 mm. They are cylindrical, the eggs flat, arranged in a single row like coins in a rouleau, — as in other *Lernæidæ.* The eggs are light yellow or greenish-yellowish. The external part of the parasite is generally somewhat chocolate-coloured from brown pigment, arranged in smaller or larger specks and longitudinal stripes. Young individuals, still without eggs, appear unpigmented, whitish. Through the cuticle part of the intestine, the ovaries, oviducts and cementing glands may be seen. The part hidden in the tissues of the host is yellowish with numerous drops of oil shining through. The length and shape of this internal part varies a good deal. One specimen, projecting near the middle line of the back in front of the dorsal fin of a fish of 42 mm. length, reached through the muscles, past the vertebral column, between two ribs to the small intestine; its total length is ca. 13 mm., 7 hidden in the fish, 6 external; the part passing the muscles form a slender stalk of ca. 5 mm. length. Of another specimen, ca. 9 mm. in total length, and attached between the right ventral fin and the posterior pectoral light-spot of a *Scop. glac.* 33 mm. in length, about half the length appeared externally, but the slender stalk which had only a thin layer of muscles to penetrate, has only a length of 0,6 mm. Just inside the body wall the parasite broadens evenly towards the anterior end; following the curvature of the posterior appendix pylorica it reached under the air-bladder and right lobe of the liver to the oesophagus. A third individual (still unpigmented and without eggs), fixed near the back on a line with the root of the pectoral fin of a fish, 55 mm. in length, only protruded with 4,8 mm. externally, while 8,2 mm. were hidden in the host. It went nearly straight down through the muscles, curved in front of the right pronephros over the upper pharyngeal bones and had its anterior end lying in front of the left pronephros, with the sucking apparatus close to the jugular vein. The greater part of the internal portion of this specimen is narrow and slender.

In all specimens examined the anterior part sends out from each side a large, clumsy process, generally shaped like a cushion (Figs. 7, 8, pr.); sometimes more as a sausage (Fig. 10 pr.); behind the processes follows an elongated, straight or curved portion, tapering gradually into a stalk and at the same time acquiring a more and more thick cuticle; outside the host it widens — sometimes abruptly — into the ovoid part, carrying the genital openings with the egg-strings. Behind the latter a short conical part may be more or less pronounced and feebly bent dorsally.

The anterior part with the two large lateral processes is the cephalothorax; in front of the processes are seen two pairs of antennæ, the mouth-sipho, maxillæ and one pair of maxillipeds (according to some authors = the second pair of maxillæ); immediately behind the cephalothorax a very short part of the elongated portion represents the abdomen (or thorax), composed of three, still quite discernible segments; the two anterior of these are provided each with a pair of feet, while an anterior pair of feet takes origin from the cephalothorax. By far the greatest portion of the whole parasite is made up by the enormously developed genital segment, as in other *Lernæidæ;* the remaining part of the postabdomen, probably only representing a single segment, is the above-named small conical end.

Closer examination of the anterior part shows that most of the Copepod-structure is pretty well preserved; the shape of the dorsal shield is quite recognizable; below its anterior margin a longitudinal thickened ridge to strengthen the antennæ runs from the base of the latter to below the antennules: from here a similar, but longer and curved, thickened line runs up over part of the dorsal shield towards the middle line, without reaching its fellow from the opposite side (*l*, Fig. 8). No eyes are visible.

The antennules (a_1) are short, indistinctly segmented (probably 4 segments), along the front margin and at the distal end provided with setæ; especially the distal ones are fairly long. The antennæ (a_2) are cheliform, composed of 3 segments. The basal segment is strengthened by chitinous ridges; the terminal segment or movable finger of the chela is sickle-shaped, its point acting against a fairly strong process from the middle segment; the latter has between this process and the articulation for the terminal claw a thin low crest or keel. Below the front end of the cephalothorax protrudes the large sipho (*si*), strengthened at the base on each side by a chitinous ridge, running backwards past the origin of the maxillipeds (*l*, Fig. 8). The mouth-opening is funnel-shaped; the margin of the funnel appears slightly haired owing to numerous chitinous striæ radiating on its inner face; two small pointed processes project from its dorsal wall (the upper lip); besides, the points of the mandibles are seen in the interior of the sipho. The outer portion of the latter, behind the funnel, is strengthened by chitinous rings, one of which is stronger than the others.

On each side of the base of the sipho is seen the maxilla (*mx*) (maxillula), short, clumsy and ending with two strong setæ. The maxillipeds (or second pair of maxillæ) consist each of 3 segments; the front margin of the basal segment carries a denticle, about at the middle; distally on the outer side of the second segment is found a similar, but smaller denticle; the terminal segment is sickle-shaped and obliquely striated (owing to densely set hairs or lamellæ). A pair of second maxillipeds is wanting.

The large "anchor-processes" (*pr*) originate below the margins of the dorsal shield.

As in other Parasitic Copepods the foremost abdominal (or thoracic) segment is coalesced with the cephalothorax. Three free terga for the other abdominal segments are developed, decreasing in size backwards, the hindmost being quite narrow. Generally, quite fine transverse lines may be traced from the front margins of the terga running across towards the ventral side; sometimes also a similar line may be traced from the anterior segment, coalesced with the cephalothorax.

Of the 3 pairs of abdominal (or thoracic) feet the two anterior possess two rami, the last pair only one ramus (Fig. 10). Each ramus is bisegmented. The distal segment carries 7 (that of the last pair only 6) setæ with extremely delicate plumules; the outermost seta is shorter than the rest. The proximal segment carries one seta on its inner corner; this seta is long on the outer ramus, short on the inner. The basal segment of each foot has a seta at its outer end, just outside the articulation for the outer ramus. On the ventral margin of the basal segment of the first pair, medially to the origin of the inner ramus, is found a quite short seta. As already stated, the first pair of feet originates from the cephalothorax, the second from the first free abdominal segment, the third from the second; while the third segment is without feet. Ventrally between the feet sterna are developed, with a strong transverse ridge joining the members of each pair. In front of the first pair is a Y-shaped thickening on the cephalothorax; and behind the last pair a thickened transverse line on the abdomen.

The elongated genital segment is densely striated transversely (this structure disappears on treating with a solution of potash). The genital openings are provided with strong chitinous lips (Fig. 9, *o*); between them a spot is always observed, possibly where the copulatory openings have once been (Fig. 9*). The last post-abdominal segment carries on each side of the anus a small wart, evidently the furcal appendage, but completely devoid of setæ (Fig. 9, *f*).

Young stages, still unpigmented and pale, do not project with more than ca. 0,8 to 2,5 mm. outside their host. Closer examination shows that they deviate still less from the Copepod-shape than do the adults. I shall describe these stages later, comparing them with the stages of metamorphosis which precede the state of insertion into the body of the fish.

That our parasite belongs to the family *Lernæidæ* is evident; in many points it agrees with genera like *Pennella, Lernæa, Lernæenicus* and *Peroderma.* The 3 first-named possess 4 pairs of abdominal feet, the two anterior biramous, the two posterior uniramous; for this and other reasons the new parasite will hardly be accepted into any of these genera; more likely it might be included in the genus *Peroderma,* as the latter has only 3 pairs of swimming feet; but as we shall see presently, various structural differences seem to justify the establishing of a new genus and species for our parasite. I propose for it the name: *Sarcotretes scopeli,* and give the following diagnosis:

Sarcotretes n. g. Body elongated; the middle portion of the genital segment constricted into a narrow, firmly chitinized stalk, only the distal, claviform part behind the stalk projecting outside the host; antennules linear; antennæ cheliform; one pair of maxillipeds; three pairs of abdominal feet, the two anterior biramous, the posterior uniramous; three free abdominal segments with terga and ventral sterna well developed.

S. scopeli n. sp. Cephalothorax with two large, thin-walled (ventro-) lateral outgrowths; no other outgrowths present. Dorsal shield fully preserved, oblong, with an upper chitinous curved line on each side; other chitinous stripes under the front margin, and along the base of the sipho; tergum of hindmost abdominal segment small and narrow.

Inserted into the body of *Scopelus glacialis,* the body wall of which it pierces, penetrating to the alimentary tract.

The genus *Peroderma* was established by Heller (1865, 10, p. 250) for the species *P. cylindricum* (l. c. Pl. XXV, Fig. 6), which penetrates the lateral muscles of the Pilchard in the Mediterranean. H.'s description and figure were rather incorrect and were improved by Richiardi (1875, 18 a). In the meantime Cornalia had named the same parasite *Taphrobia pilchardi* (5) without describing it better; both Heller and Cornalia only had one specimen at their disposal, and that of Heller was damaged. Richiardi showed that this parasite at its anterior end is provided with a system of branched appendages; he described antennæ, maxillipeds, swimming-feet etc. and gave a new diagnosis of the genus. Later (1881, 12 b) Richiardi briefly described a second species, *P. petersi,* deeply implanted into the body of *Gobius buccatus* C. V., and a third one (1882, 18 c) *P. bellottii,* inserted into the branchial arterial stem of *Scopelus benoiti.* The latter species I think is identical with that figured on Pl. II, Fig. 27, as this agrees in every essential point with the short description by Richiardi (as far as I know, the more complete description and the figure promised by R. (18 c, p. 150 and 475) have never been published)[1]). I found this parasite in numerous adult specimens on *Scopelus glacialis* and *Sc. rafinesquii,* collected by the "Thor" in the western part of the Mediterranean, in, and close to, the Straits of Gibraltar (on Station 99 of 96 specimens of *Sc. glacialis* 28 were infested, of 46 specimens of *S. rafinesquii* only 3; on Stat. 59 one specimen among 149 *Sc. glacialis,* and one among 5 *Sc. rafinesquii* carried the same; and on St. 61 (in the Strait itself) one of 2 *S. rafinesquii*)[2]). It is always attached to the same spot of the host, namely under the isthmus, with the posterior end, bearing the egg-strings, pointing backwards and the ventral side looking towards the belly of the

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[1]) Brian (3, p. 94) repeats Richiardi's description, and only adds the following: "Due esemplari sporgenti fuori dell' angolo boccale dello *Scop. caudispinosus* Johs. furono trovati in Genova il 18 Maggio 1908". The figures, referred to, are Pl. VII, Fig. 2, and Pl. XIX, Figs. 2—5; but what is represented there has nothing at all to do with any *Peroderma* whatsoever!

[2])

"Thor"s St. No.	Lat. N.	Long. W.	Depth of capture	Date
99.	36° 02′	5° 16′	150 Met.	23/6 1910.
59.	36° 12′	4° 21′	9—1200 —	21/2 1909.
61.	35° 52′	5° 35′	300 —	21/2 1909.

fish. All specimens examined had the richly branched system of "frontal" appendages inserted into the bulbus arteriosus, the latter being distended to such degree, that it far surpassed in size the ventricle (cfr. Pl. I, Fig. 27 *b* and *v*). Nevertheless the infested specimens looked quite as healthy and well nourished as those free of the parasite.

The three species of *Peroderma* all possess branched appendages from the front end of the cephalothorax[1]). According to Richiardi's figures of *P. cylindricum* the distance between the second and third pair of swimming feet is very great, and in this interspace are found a pair of peculiar chitinous ridges; no terga of abdominal segments are mentioned or figured. Regarding *P. petersi*, which has not been figured, it is said that 4 pairs of feet are present, following each other at short distances, and that the egg-strings are "spirally directed" (after these statements the species seems to me somewhat doubtful as a member of the genus

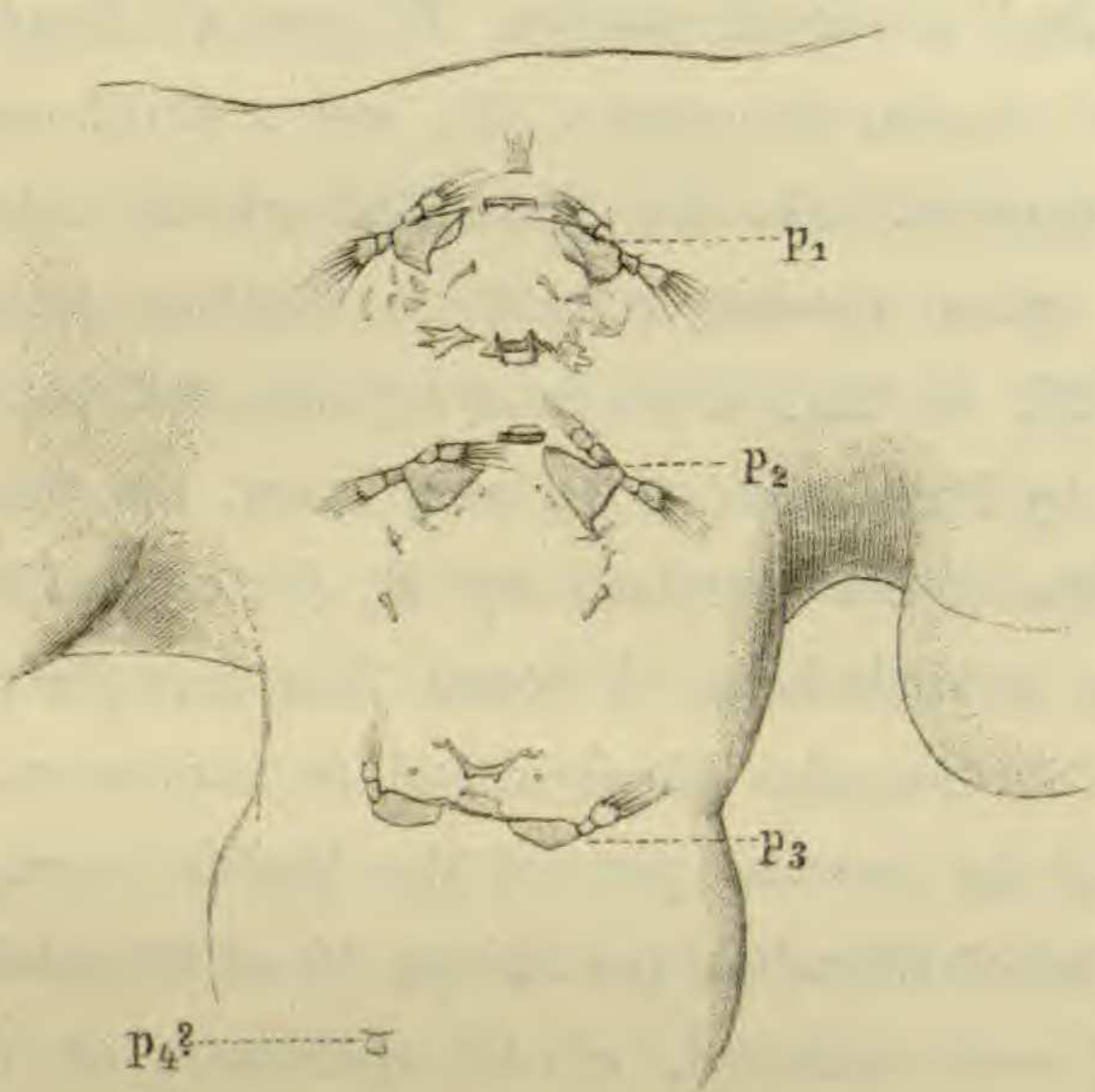

Fig. 1. *Peroderma bellottii.*
Part of ventral side of body, between the two large lateral outgrowths. p_1—p_3: first to third pair of abdominal (thoracic) feet; p_4?: rudimentary structure, perhaps representing the right foot of a fourth pair.

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[1]) C. B. Wilson has (23, p. 458, Pl. LXXVI, Figs. 99—100) described a "*Lernæenicus medusæus*" taken on *Nannobrachium leucopsarum* at Monterey, Calif., which may belong to the genus *Peroderma*, as it very much resembles *P. bellottii*. But it is said to possess only 2 pairs of swimming feet, with single rami, and the author adds: "No other appendages are visible", and that no sipho is to be seen. These statements seem to me somewhat doubtful. The place on the host is not mentioned.

Peroderma). *P. bellottii*, which I have examined myself, has only 3 pairs of feet developed; but behind the last pair a merely rudimentary structure is seen, which may perhaps represent a fourth pair. The 3 pairs are arranged with large interspaces (cfr. text-figure 1, pag. 12), in which small symmetrically scattered chitinous parcels are found, looking like ventral parts of the segments, burst from each other by the distension of the body during its growth. The feet, compared with those of *Sarcotretes*, are smaller and of a somewhat different shape, and the same may be said regarding the antennæ, first maxillipeds and sipho; further there is a vestigial pair of 2nd maxillipeds (like those of *Lernæa branchialis*) about midway between the first maxillipeds and anterior pair of feet; the dorsal shield of the cephalothorax has quite another shape, being distended and burst into pieces at the margins, probably a consequence of the greater development of the two lateral processes, which are here somewhat asymmetrical and clumsily branched at their outer ends. Only the first of the abdominal terga seems preserved; it is here asymmetrically turned to the left side on a slight swelling immediately behind the large processes. These differences together with the presence of the branched "frontal" appendages seem to me to prevent the inclusion of my *Sarcotretes* in the same genus. Speaking generally, the latter shows more likeness to the genus *Lernæenicus*, f. ex. *L. encrasicholi* (Turton) which I know from my own examination[1]; but, as already stated, this genus possesses four pairs of feet.

2. The stages of metamorphosis (Pl. II, Figs. 11-15, 22-26).

A. The youngest stage which I have found agrees in the main features with the stage of *Lernæa branchialis*, which Claus

[1]) This species has a short median outgrowth from the dorsal side of the cephalothorax about at the level of the two large lateral processes, and furthermore on the ventral side, in front of the maxillipeds a pair of short, clumsy outgrowths. These structures as well as the maxillipeds and maxillæ have been overlooked by A. Scott (19 b, p. 94, Pl. II, Figs. 6—9).

(4, p. 22, Pl. IV, Figs. 1—5) describes as "die erste Cyclopsform" (the "Cyclopid-stage" of Pedaschenko (17, p. 279)) and with the "Cyclopsform" described by Wierzejski (22, p. 571, Pl. XXXII. Fig. 4), found on the gills of Cephalopods and supposed by W. to belong to a species of *Pennella*. I only succeeded in finding 3 specimens of this stage, probably arisen from a Nauplius or Meta-nauplius (embryonic Naupliæ I did not find in the preserved egg-strings, and consequently I was not able to isolate any). The specimen figured on Pl. II, Fig. 11—12 was found attached to the left side above the pectoral fin of a young *Scop. glacialis*, only 12 mm. in length. The other two were both fixed on a *Scop. gl.*, 25 mm. in length, the one to the left ventral fin, the other to the left pectoral. They were all attached by means of their strong cheliform antennæ. Evidently this stage is capable of active wandering from one spot to another of its host, probably also of swimming along for a while and attaching itself again. This seems to be proved by the whole elegant Cyclops-shape, the proportionally large swimming feet, the antennules etc. The length is between 0,448 and 0,5 mm. Of the specimen figured, ca. 0,5 mm., the elongated ovoid cephalothorax makes up 0,352 mm., the rest 0,112. The rostrum is curved downwards. The antennules are provided with sense-hairs along their front margin and with long setæ distally, at least of half the length of the cephalothorax. The antennæ are strong and projecting, the stout basal segment almost vertically bent against the cephalothorax; of their three segments the basal one is nearly cylindrical and strengthened by chitinous ridges, while the remaining two form a large chela, the longitudinal axis of which is parallel to the cephalothorax. The terminal segment is a long, elegantly awl- or sickle-shaped claw with a curved point, acting against a sharply pointed process on the elongated second segment; the latter carries at some distance another somewhat smaller hook. The sipho is relatively short; laterally it carries the maxilla (*mx*) with its two stout setæ, and just above the root of the maxilla a fairly long, slender appendage ending in a single long seta (*md*); this I take to be the mandibular palp. One pair of maxillipeds is present, strong, 3-segmented (mp_1); the basal segment has a small denticle on its anterior margin; the terminal segment is a curved, somewhat compressed claw, obliquely striated laterally. The cephalothorax is provided with chitinous thickened lines arranged as in the adult. No eyes are visible. Behind the cephalothorax are 3 distinct abdominal segments and one terminal, representing the postabdomen and bearing on each side of the anus a well developed furcal appendage with setæ (*f*). There are two pairs of strong swimming-feet, the anterior originating from the ventral margin of the cephalothorax, the second from the first abdominal segment. Each foot consists of a strong basal joint and two rami; each of the latter has only one segment with long setæ, provided with delicate plumules. Each furcal appendage has 4 setæ, the two inner of which, especially the innermost, are long and feathered.

Upon this "actively fixed" stage A, the Cyclops-stage, follows a series of "passively fixed" stages, probably representing as many moultings; they may be called "Pupal stages", as Claus has done in the case of *Lernœa branchialis*, and Wierzejski with the corresponding stages of the Lernaeid, supposed to be a *Pennella*. They are more or less clumsy, with the abdominal feet adpressed and provided — like the antennules — with more or less clumsy setæ or devoid of such, according to the grade of development. The antennæ are relatively short and clumsy chelæ, situated below an elongated rostrum and evidently not fit for grasping. The fixation is brought about by the rostrum; from the end of the latter projects an appendage with a terminal disc firmly cemented to the skin of the host. This appendage is undoubtedly a hardened secretion produced by glands in the front end of the cephalothorax; it is firm like chitine, resisting like the cuticula itself the action of potash; a pear-shaped swelling marks it off from the rostrum proper. I have not been able to see any composition of layers in the swelling, like those observed by Claus in the pupæ of *Lernœa branchialis*, where the number of moultings may be judged directly from them; in all the present pupal stages I find the structure to be identical.

The total number of pupal specimens found is 34; according to grade of development, size, shape of the setæ etc. they may be grouped into four stages, in the following designated as B, C, D and E. The younger stages are less numerous in my material than the older. All are attached by means of their frontal appendage to *Scopelus glacialis* of 14 to 46 mm. length, mostly to young specimens below 30 mm. Generally each fish has only one pupa attached; but in one case I found two different pupal stages (B and D) fixed on the same host (on the right pectoral fin of a *Sc. gl.* of 28 mm. length), which besides had a young female inserted in front of the dorsal fin; in another case I found one pupa (D) on a *Scopelus* which also carried a young female protruding in front of the dorsal fin. In most cases the pupæ are attached to the fins (in 28 cases of the 34), and especially to one of the ventrals (in 13 out of 28 cases), rarely to the body, and in the latter case mostly to the belly in front of the ventrals; in one single case a pupa was found on the margin of the right opercle. Evidently the pupæ do not prefer the one side of the host to the other, half the number being found on the right, the other half on the left side. Their fixation is always a firm one; to liberate without damaging them it is safe to use a solution of potash. As in the adult and the Cyclops-stage no eyes are seen in the pupal stages, opposite to the case of *Lernæa branchialis* and the supposed *Pennella*-pupæ of Wierzejski.

Stage B. (Textfig. 2 and 3.) The youngest pupal stage I suppose to have been produced through the moulting of the Cyclops-stage A. It is somewhat larger than the latter, measuring from 0,7—0,8 mm. in length; the cephalothorax alone 0,5—0,6 mm. Behind the cephalothorax only two abdominal segments are seen, followed by an unsegmented part, carrying the anus and very short furcal appendages with 4 clumsy indications of setæ. The antennules are clumsy, short, without segmentation, distally provided with some very short setæ. The antennæ do not reach to the end of the rostrum, their chelæ are weak and unfit for grasping. The sipho is very large; the maxillæ and mandibular palps well developed, the maxillipeds long, their terminal claw clumsy. In some individuals a second (posterior) pair of rudimentary maxillipeds is present; these specimens are males. Chitinous ridges on the

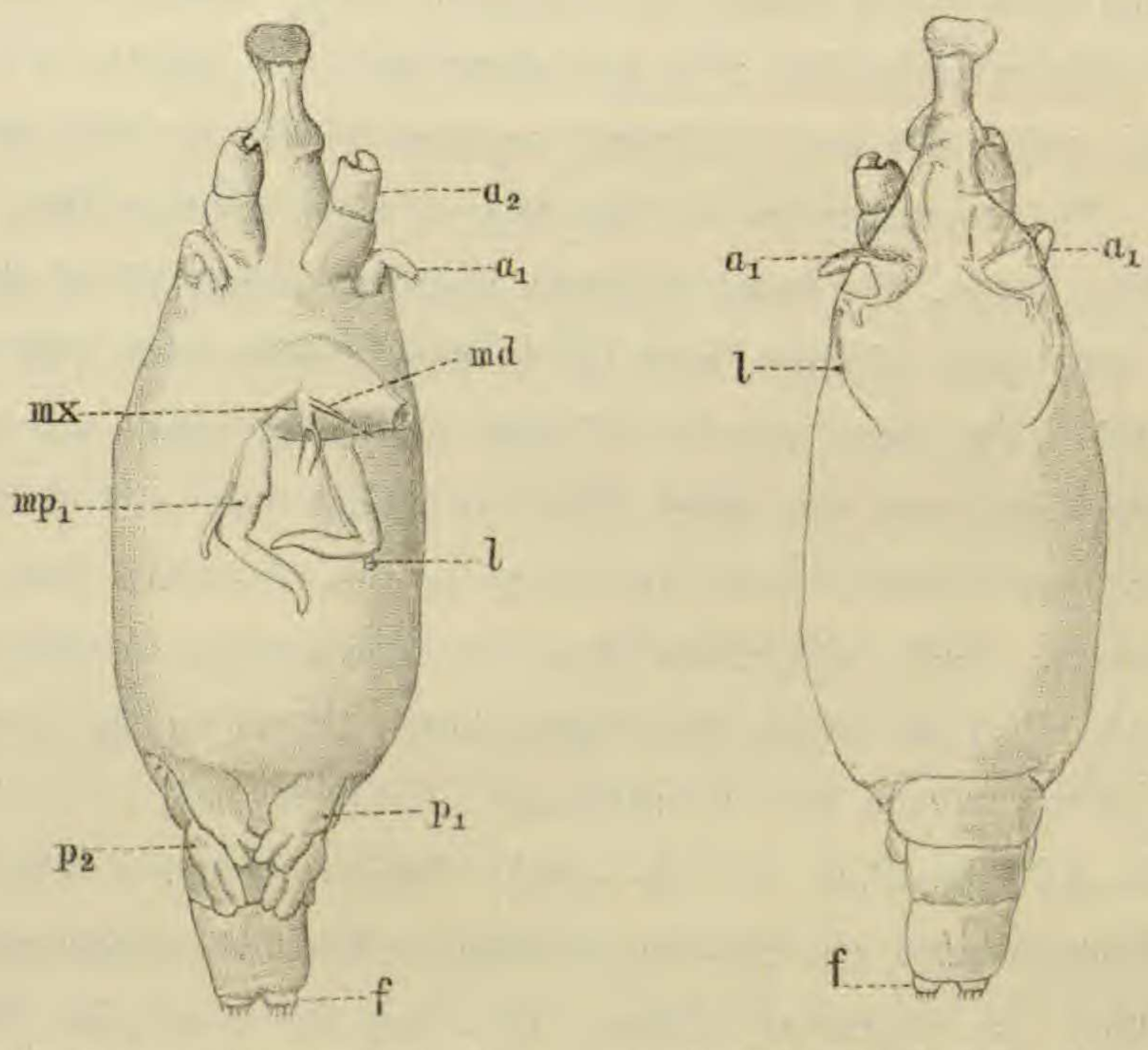

Fig. 2. First pupal stage (B) from ventral and Fig. 3 from dorsal side. a_1 antennule; a_2 antenna; *md* mandibular palp; *mx* maxilla; mp_1 first maxilliped; *l* chitinous thickenings; p_1, p_2 first and second abdominal (thoracic) feet; *f* furcal appendage.

cephalothorax arranged as in the Cyclops-stage and the adult; the same is the case with all the following stages. Two pairs of abdominal feet are present, both biramous and quite without setæ; they are not distinctly segmented but slight incisions mark off a basal portion and two parts of each ramus.

C. (Pl. II, Fig. 13.) The next pupal stage has a length of ca. 1 mm. (the cephalothorax alone being ca. 0,82 mm.). A third abdominal segment is now indicated. The antennules, antennæ etc. are in the main like those of the preceding stage, but a third pair of abdominal feet is now present as short, flattened appendages to the second abdominal segment; a division into a basal segment and ramus is indistinctly indicated. The distal setæ of the antennules are somewhat larger, and the two biramous feet now show a set of extremely short setæ; the furcal setæ are much as in the stage B.

D. (Pl. II, Figs. 14, 23). The following stage is ca. 1,6 mm. in length (the cephalothorax 1,12 mm.) Antennules, antennæ, maxillipeds and feet are still clumsy; the abdomen has three distinct segments. Third pair of abdominal feet has about half the length of the two anterior pairs; the last abdominal segment is without feet as in the adult. The segmentation of the feet is more marked than in the preceding stage, the basal segment and two segments of the rami being now quite distinct, most so in the anterior pair (cfr. Pl. II, Fig. 23). The same number of setæ as in the adult are present, and the setæ are now much more developed but still clumsy and pressed against each other; the same is the case with those of the antennules. Male specimens show the second pair of maxillipeds (Fig. 14 mp_2) as short, bent appendages about on the level with the "elbow" of the first maxillipeds.

E. (Pl. II, Figs. 15, 24—26.) Stages of ca. 2 mm. length (the cephalothorax ca. 1,36 mm.) seem to be the last pupal stages producing the copulatory form. This may be concluded from the following observations: 1) inside the cuticle of this stage is seen a Copepod-form resembling the adult in many details; 2) a proportionally great number of specimens of this stage has been found, but not a single pupa of larger size or more developed. In this stage the general shape of the body and its appendages are less clumsy than in the preceding; all the setæ are much longer, the segmentation of the feet more pronounced; the postabdomen — including the future genital segment — is now about of the same length as the abdominal segments taken together. The setæ appear more free of each other, and those of the feet show delicate plumules at their extreme, very thinwalled ends (Textfigure 4). Enclosed below the cuticle of this pupa another Copepod-form is seen;

inside the pupal antennæ is distinctly seen a longer and more sickle-shaped claw, quite resembling that of the adult parasite; in the antennules and their setæ the corresponding structures are visible in a more developed form; and in the abdominal feet are very conspicuous distinctly segmented swimming-feet, in every detail agreeing with those of the adult; the long and elegant setæ with their delicate plumules are ensheathed in the shorter and bigger ones of the pupa (cfr. Fig. 24), and in the furcal setæ of the latter the longer ones of the next form show plumules. Any genital openings I have not been able to observe.

In casting off the pupal cuticle this enclosed Copepod probably gives up the fixed condition. As young males and females they leave the empty pupal shells on their former host, swim away and live for a while in a free state, in which they copulate. After copulation the males probably die, while the impregnated females again seek the same species of fish and take up the parasitic life anew, but in a more intense form: they pierce the skin of the fish and, gradually growing, penetrate through the muscles and reach by and by to the intestines of their host. The course of events here set forth, I am sorry to say, is not founded on direct observation; but any reader remembering the facts known from *Lernæa branchialis* will certainly find the above conjecture fairly plausible.

Fig. 4. Last pupal stage (E). Terminal part of setæ of foot, showing extremely delicate plumules.

Directly observed are some early stages of the boring parasite, the structure of which does not deviate very much from that of the Copepod, seen enclosed in the pupa E. As before mentioned they appear externally like small, pale cones of 0,5—2 mm. length, protruding through the skin of *Scop. glacialis*. I have dissected out 3 specimens. The one has a total length of 6 mm.; it projected as a 2 mm. long, slender thread from the back, just in front of the dorsal fin, of a fish of 57 mm. length; it was only inserted into the muscles and did not reach the vertebral column; the mouth and feet were turned towards the surface of the fish. The other, figured on Pl. II, Figs. 16—18, had an external part of only 1 mm., peeping out of a pit in front of the dorsal fin of a *Scop. glac.* of 25 mm. length. It has pierced the whole musculature and reached between two ribs through the peritoneum, on the inside of which the mouth could be seen; the feet looked towards the vertebral column. The total length is 4 mm.; the cephalothorax is about 1 mm (0,96 mm.), the 3-segmented abdomen 0,240, the remaining ca. 3 mm. are almost entirely made up by the genital segment; the latter is densely striated transversely, and by a very feeble furrow indistinctly marked off from the end segment, carrying the small furcal appendages devoid of setæ. The genital openings are recognizable at the posterior boundary of the genital segment. Except the elongation of the genital segment and the reduction of the rostrum the shape of the animal is that of the stage inside the oldest pupa E. The details of the strengthening ridges of the cephalothorax and antennæ are the same through all stages, also those on the sipho; but the mandibular palp of the larva and pupæ appears now to have vanished.

The third specimen shows a step further towards the final shape (cfr. Pl. II, Figs. 19—21). It projected in front of the dorsal fin of a fish of 25 mm. length; the internal part perforated the muscles, passed close to the vertebral column between two ribs into the abdominal cavity, the mouth lying close to the left side of the small intestine at the origin of the hindmost pyloric appendage. The total length is 6 mm.; the cephalothorax 0,96 mm., the abdomen 0,277 mm., the rest ca. 5 mm. The genital segment is still more elongated, and more swollen posteriorly than in the former, the greatest diameter being 0,320 mm. while that of the cephalothorax is 0,40. Between the genital openings is seen a chitinous spot, probably where the copulatory openings are obliterated. The most marked difference from the two preceding specimens is that the lateral processes of the cephalothorax have appeared in the shape of thinwalled, wing-like outgrowths ventrally to the margins of the shield; they reach from the level of the maxillipeds to the posterior end of the cephalothorax.

II. The Hydroid.

Seven specimens of the Hydroid have been found; 3 of these consist only of polypes, 4 carry besides sexual individuals. The polypes are all of one kind, functioning at the same time as hydranths and as blastotyles. They originate from a network of anastomosing tubes united by a thin membrane. The membrane and hydrorhizæ are without perisarc as well as the polypes. According to the size of the colony the membrane coats a greater or lesser part of the external portion of the *Sarcotretes scopeli*, described above. As the latter always turns the ventral face, on which the Hydroid is attached, towards the fish, a shelter is provided for the Hydroid. Larger colonies cover the whole ventral face of the parasite and embrace more or less also of its sides, but leave most of the dorsal face free; only round the base of the stalk the membrane may close as a ring. Generally only adult, egg-bearing parasites carry the Hydroid; but in a single case a *Sarcotretes*, which had evidently not yet formed egg-strings, was found provided with a Hydroid-colony (Pl. I, Fig. 6). The youngest Hydroid found had only a single, and still undeveloped polype, in which no mouth was perceptible (Pl. I, Fig. 4); another young colony contains 1 large and 4 smaller polypes (Pl. I, Fig. 5); a third has several polypes and coats most of the ventral face of its Copepod. In two colonies a single or a few polypes bear medusæ-buds; and in the remaining two most of the fully developed polypes carry at their base a number of buds in various stages of development, some of them quite medusiform, showing two tentacles. Most richly provided appears the specimen figured Pl. I, Figs. 1—3; the medusæ are here so numerous and prominent that they are the first to attract attention and determine the aspect of the whole colony.

The polypes are completely devoid of tentacles; their mouth is often expanded into trumpet-shape. When the mouth is expanded the oral entoderm is everted to form the disc or trumpet. Immediately below the disc is seen a narrow, feebly thickened ring, consisting of cylindrical ectoderm-cells somewhat higher than those of the rest of the body. Inside this ring the entodermal circular muscle-fibres are more strongly developed than in the remaining part of the body, these fibres evidently acting as a sphincter. When the mouth is closed, the ring-cells bound the mouth-pore.

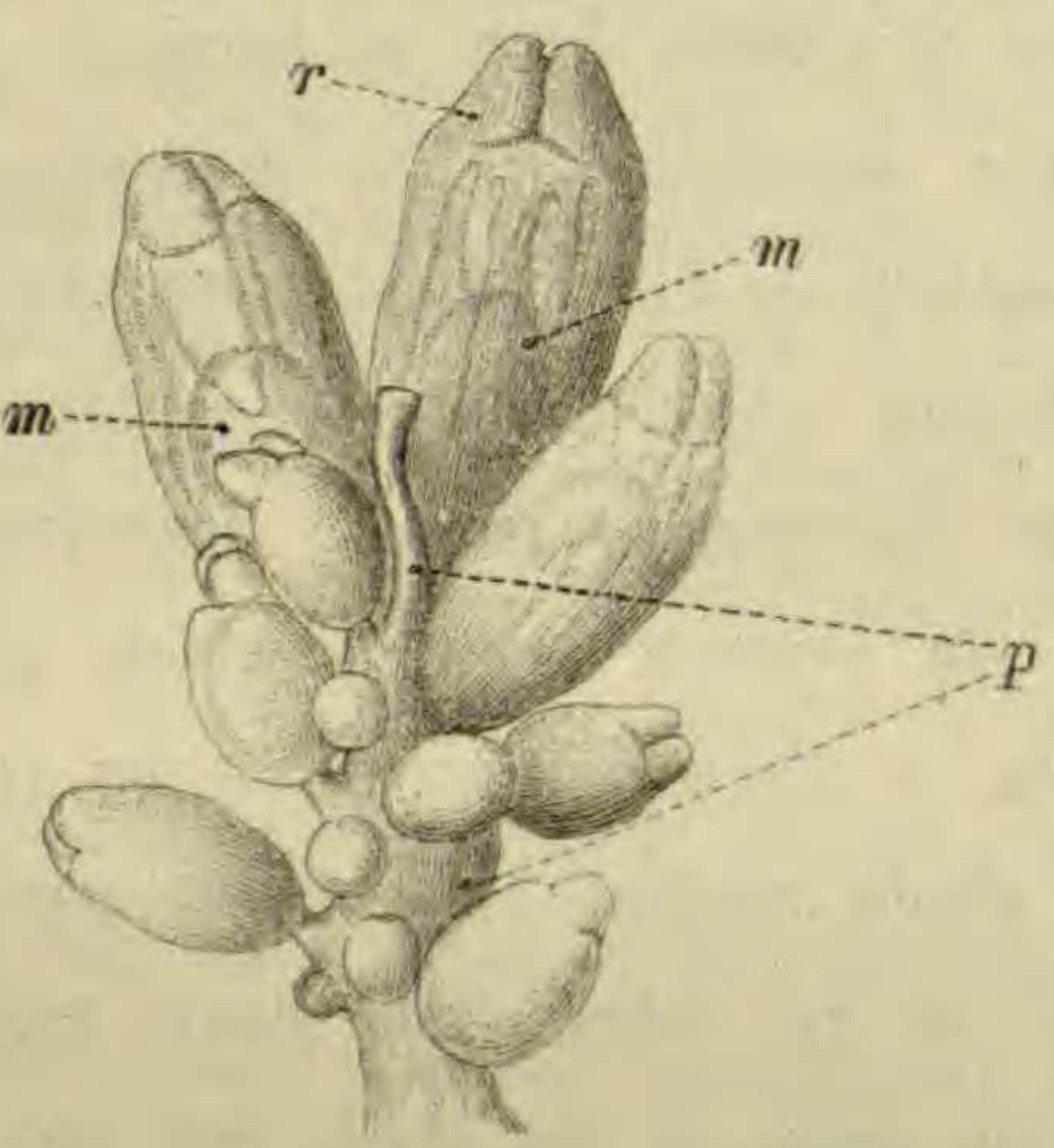

Fig. 5. *Ichthyocodium sarcotretis.* Polype carrying medusæ-buds. *p*: polype; *m*: manubrium of medusa-bud; *r*: marginal tentacle, the greater part of which is bent up inside the bell and indicated as seen through the latter.

The body is cylindrical or claviform, sometimes goblet-shaped; the total length ca. 1—1,5 mm., the diameter from 0,048 to 0,176 mm. In the outer ectoderm of the membrane are numerous fairly large nematocysts, but I have not been able to detect any nematocysts whatever in the ectoderm of the polypes. In the most developed colony (Pl. I, Fig. 1) the largest polypes are found on the ventral side of the parasitic copepod turned towards the fish (therefore not shown in the figure). A proportionally great number of these large polypes (1,5 mm. or somewhat more in length) do not carry any medusæ-buds; but as a few of them bear a single large bud, some others a few small buds at their base, no definite demarcation between sterile and fertile polypes can be drawn, as already stated. Towards the margins of the colony almost all polypes are fertile. The distal part of those polypes which carry a great number of medusæ-buds — up to ca. 20 — is generally very slender and easily overlooked while more or less concealed among their buds (cfr. textfigure 5); but polypes with only a few or only small buds may have quite the same shape as those without any buds at all.

The medusæ-buds are found in all stages and sizes; the largest ones show clearly that they will be set free as real medusæ. Already tiny buds, of 0,160 mm. in diameter, have distinct rudiments of two marginal tentacles; in larger buds these have quite a considerable size but are still clumsy; nevertheless the tentacles are easily overlooked in many of the largest buds, because they have been bent up and concealed inside the umbrella. In the latter case the medusæ-buds appear elongated, fusiform (Pl. I, Fig. 2 *me*) and at first sight do not resemble medusæ at all; in clearing with glycerine or xylol etc. the marginal tentacles and the other medusoid structures are easily observed. There is a short manubrium; no mouth is yet formed, neither are there any indications of mouth-tentacles. In transverse sections the cavity of the manubrium is quadrangular; a narrow canal connects it with the gastric cavity of the mother-polype. The umbrella contains four distinct, wide and simple radial canals, connected distally by a ring-vessel; a velum is indicated as an outgrowth from the ectoderm of the subumbrella.

Fig. 6. *Ichthyocodium sarcotretis.* Medusa bud. *m*: manubrium; *r*: marginal tentacle.

The exumbrellar ectoderm contains numerous large nematocysts (ca. 0,004 mm. in diameter), most of them arranged as a broad band across the bell; this band may be distinctly seen already in quite young buds. The tentacles originate opposite the distal ends of two radial canals; they are hollow, their cavity connected with the ring- and radial vessel; no pigmented eye-spot is seen at their base. Between the tentacles the margin of the bell shows a small projecting fold at the ends of the other two radial canals, possibly indications of a new pair of tentacles, developing after the liberation of the medusa. Even in the most developed stage observed the tentacles appear clumsy, finger-shaped, somewhat shorter than the bell (Fig. 3). Sometimes they are bent in the way shown in textfigure 6; in this case they may be mistaken as going to branch into a group of two.

The largest medusæ-buds are fusiform or cylindrical, attached to the mother-polype by a pointed top. One of the largest measures from the point to the margin of the bell 0,40 mm., to the bent angle of the tentacle 0,490 mm., the greatest diameter of the bell being 0,192 mm.; another measures from its top to the distal end of the tentacle 0,62 mm. with a diameter of the bell of 0,232 mm. Genital cells I have not been able to observe; probably they will be found in the manubrium of later stages.

The facts mentioned clearly show that our Hydroid has to be classified with the Gymnoblastic Anthomedusæ. As it does not in every point agree with any other form known to me I propose to name it: *Ichthyocodium sarcotretis.* n. g., n. sp.

Besides *Protohydra, Microhydra* and the hydroid stage of *Limnocodium* a few Hydroids are known, the hydranths of which are completely devoid of tentacles. Among undoubtedly gymnoblastic Anthomedusæ I have only found four mentioned; they are all epizoic like our new form, a fact which seems to me of some interest. *Ichthyocodium* shows most likeness to *Hydrichthys mirus* Fewkes. This form was found in 1887 at Newport by Fewkes (7 *a* and *b*), growing on the skin of the fish *Seriola zonata* Cuv. The colony is attached by a thin flat membrane, containing a meshwork of tubes, to the skin of the fish in the neighbourhood of the anus. The membrane is said to be leathery, but without perisarc. From the tubes grow polypes of two kinds: 1) naked gonosomes, like clusters of grapes, consisting of an axial stem the terminal end of which is provided with a mouth-opening, and numerous branches; the latter are of the same structure as the stem, but closed terminally, where they carry clusters of medusæ-buds in various stages, up to medusiform bodies with two clumsy tentacles. The terminal part of the stem does not carry medusæ-buds, is devoid of tentacles, and its margin is entire. 2) Filiform polypes, supposed to be hydranths; they are described as flask-shaped bodies, resembling the palps of *Siphonophores* or the spiral zooids of *Hydractinia* (they are said to move in a similar way to the latter);

they, too, are devoid of tentacles and (probably) possess a mouth-opening, the terminal end sometimes appearing trumpet-shaped. 3) The medusæ. The largest buds are elongated, cylindrical; in the fixed state they do not develop more than two, clumsy tentacles; their surface is speckled with nematocysts (most distinctly seen in the younger stages, still before the medusoid shape is recognizable). When liberated — the fish was kept in an aquarium, and great numbers of medusæ were set free — they at first resemble a young *Stomatoca* (the medusa of *Perigonimus*), having an ovoid, upwards rounded bell, four simple radial canals and ring-vessel, and a proboscis with entire mouth. Later the medusa acquired four tentacles, two new growing out in the interspace of the two first formed. When all four are fully developed it resembles a *Sarsia*. In this stage, possessed of four long and slender tentacles, the medusæ sank to the bottom and died.

If we suppose that the medusæ of *Ichthyocodium*, when set free, also acquire four tentacles — which seems to me at least probable — they would agree with those of *Hydrichthys*; in the attached state, as buds, the likeness is practically complete. The differences of some amount between *Hydrichthys* and *Ichthyocodium* are the following: 1) the basal membrane in the first is firm, leathery; 2) the polypes are of two kinds, sterile and fertile ones; 3) the medusæ-buds are clustered on the ends of branches or stalks from the fertile polypes. According to the figures given by Fewkes (the author does not give any measurements of the polypes, buds or medusæ), the size of the colony in *Hydrichthys* surpasses that of the largest *Ichthyocodium* found; but it is by no means impossible that the latter may acquire a larger size and fuller development than the specimen figured Pl. I, fig. 1.

In 1907 R. E. Lloyd described a *Nudiclava monocanthi* growing on the fish *Monocanthus tomentosus* from the Andamana-Sea (13). Like the preceding this Hydroid is attached by means of a naked basal membrane, containing tubes from which naked, claviform hydranths without tentacles grow (0,75 mm. in length);

on their base they carry gonophores (generally each a single one). Only so far is there a likeness to *Ichthyocodium*; for the gonophores are not set free as medusæ but remain attached as sporosacs, resembling those of *Clava*, and in the same colony are found male as well as female individuals.

In 1909 Miss Winifred E. Coward (6) described *Ptilocodium repens*, epizoic on the Pennatulid *Ptilosarcus sinuosus* (Gray) (captured by the Siboga-Expedition at 9° 03′ Lat. S., 126° 24,5′ Long. E. in 112 Met. depth); it grows along the free edges of the leaves. The colony is dimorphic having two quite distinct forms of polypes arising from tubes enclosed in a basal membrane devoid of perisarc. The hydranths or "gasterozooids" are without tentacles, naked, and possess a simple mouth-pore; they show no nematocysts and reach at most a length of 0,373 mm. More numerous are the "dactylozooids" (ca. 0,186 mm. in length), short and broad polypes bearing at the terminal end four capitate tentacles crowded with large nematocysts; mouth and internal cavity are lacking, the entoderm of the tentacles and body being solid and scalariform. The gonophores arise from the base of the hydranths; they are described as sporosacs but provided with traces of four radial canals and of four rudimentary tentacles on the closed and rudimentary bell, the superficial ectoderm of which shows nematocysts; the closed manubrium bears (female) genital cells. According to the description it seems to me at least possible that these gonophores are not real sporosacs but may carry their development further and eventually be set free as medusæ. But even if this should not be the case, I think *Ptilocodium* has no close relationship to *Ichthyocodium*, the latter showing no dimorphism of the polypes; but *Ptilocodium* apparently is closely allied to the Hydroid, which Kükenthal found growing on another Octactinia. In 1909 Kükenthal described a new Gorgonid from Japan, *Anthoplexaura dimorpha* (11), on which he discovered this epizoic Hydroid (l. c. p. 24); he mentions polypes devoid of tentacles, and others provided with tentacles (sections through one of the latter are figured l. c. Pl. VII, Fig. 37), and medusoid gonophores (Fig. 38). Later Stechow has examined in detail the same Hydroid (20 a, p. 31, Pl. III, Figs. 7—9); he has given it the name *Hydrichthella epigorgia* and referred it to the family *Corynidæ.* It is quite naked, without perisarc, with an incrusting or cushion-shaped basal coenosarc; stolons are difficult to see; the polypes are of three kinds: hydranths, devoid of tentacles ("Fresspolypen", 0,8—1,3 mm. in length), and two forms of "Wehrpolypen", both without mouth: the one (0,5—0,8 mm. in length) broader, with 4—8 short capitate tentacles in a simple whorl at the upper end; the other (0,53—1 mm. in length) more slender and resembling a long capitate tentacle. The sexual individuals are described as "sporosacs", attached singly by a short stalk to the hydranths; the ova (male specimens have not been found) are enclosed in the wall of a distinct spadix, and the envelope is provided with four distinct radial canals. Apart from the existence of 2 forms of "dactylozooids" the likeness to *Ptilocodium* appears so evident, that a close relationship can not be doubted. All specimens of *Anthoplexaura* from different localities and depths were richly beset with this Hydroid. Stechow, as already mentioned, has referred it to the family *Corynidæ*; and (20 b, No. 142, p. 152) he has also pointed out the close relationship to *Ptilocodium* and argues against the establishing of a new family for the latter. Also *Hydrichthys* is referred by Stechow to the *Corynidæ*; in so far as this will prove to be well founded, our *Ichthyocodium* has to be included in the same family. Thus this family contains the three of the above-mentioned four epizoic Hydroids devoid of tentacles.

It is mentioned above (p. 2) that the triple association of the Hydroid *Ichthyocodium* with the Copepod *Sarcotretes* parasitic on *Scopelus glacialis* is hardly quite an accidental one. I feel most inclined to consider it to be a new case of such regular associations — in some way or other fixed by law — which are known to occur among other Hydroids. That Hydroids in many cases may be found growing on living animals merely accidentally is well known. I may refer to Alcock (2, p. 207) who has collected a series of examples. From my own experience I might add a case, at first sight parallel to that of *Ichthyocodium*, namely that of *Obelia geniculata*, which I have seen flourishing on a *Lernæa branchialis* attached in the gills of the common cod; a similar case is mentioned by Sæmundsson (21, p. 29). This Hydroid as well as those mentioned by Alcock normally grow on quite other substrata; by accident they may attach themselves to living animals, and they may occur on very different organisms. If, however, a Hydroid is quite regularly met with on the same animal — or a nearly related one — and is only found there, we may be sure that we have before us some kind of symbiosis, in most cases probably a form of commensalism. To decide whether the association involves a reciprocal advantage or is beneficial only to the one part is in most cases very difficult, and a matter of mere conjecture. Alcock also mentions a number of such regular combinations (l. c. p. 208), and he adds as a new case that of *Stylactis (Podocoryne) minoi*, which he always found attached to the skin of the fish *Minous inermis*, while other species of *Minous* apparently were free of this Hydroid. Later the same has been observed at Japan (Franz and Stechow (8), Stechow 20 a; Pl. IV, Fig. 8). That after Heath (9) *Minous inermis* also may be found free of this Hydroid (Snyder is said by H. to have captured several specimens uninfested) in my opinion does not alter in any way the character of *Stylactis minoi* as a symbiotic form; hitherto it has never been found on other substrata than the body of a *Minous*. A somewhat similar association is described by Heath (l. c.): of 37 specimens of the cottoid fish *Hypsagonus quadricornis*, captured in Puget Sound (Friday Harbor), 10 were coated with *Perigonimus pugetensis*, a new species related to *P. vestitus* Allm.

As a "triple-association" between a Hydroid and a Crustacean parasitic on a fish, which perhaps is a regular one, I might mention that of *Eucope parasitica*. This Hydroid is described by Al-

Agassiz (1, p. 87) as found (more than once) on a species of *Pennella* parasitic on *Orthagoriscus mola*; later the same Hydroid was taken by Leidy (12, p. 165) on another Lernean *Lernæonema procera* parasitic on *Odontaspis littoralis*[1]). Hitherto this Hydroid has only been observed growing on Lerneans on fishes; but it is very close to *Eucope polygena*, attached to quite other substrata, and it seems questionable if this case is really different from that of *Obelia geniculata*, mentioned above. At all events the special interest which we at first sight might attach to the examples quoted of associations between Hydroids and Fishes, and still more to those between Hydroids and Lerneans parasitic on Fishes, looses very much when we consider the structure of the Hydroids in question. None of these Hydroids, neither *Stylactis minoi*, nor *Perigonimus pugetensis*, nor *Eucope parasitica* show any peculiar adaptation for their occurring on a living animal, not in the least any more than *Obelia geniculata*, usually found on quite other substrata; in no respect do they carry the stamp of being transformed owing to their peculiar habitation. Whatever the advantage may be for the one part of the association, the Fish or the Lernean, for the Hydroid it will possibly be that of getting an easier access to food supply; but the kind of food and the mode of grasping it I think must be the same as that of their nearest allies not found on living animals.

With *Ichthyocodium*, *Hydrichthys* and *Nudiclava* the case seems to be different. In these Hydroids all the polypes have lost their tentacles; probably because they get their food in another way and take another kind of food than their nearest relatives[2]). I think they depend in some way or other on the fish for food (the Parasitic Copepod in the case of *Ichthyocodium* only serving as attach-

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[1]) Whether the "*Campanularia*" which Paul Mayer (15, p. 53) found growing in great numbers on the filaments of a *Pennella (filosa?)* parasitic on *Xiphias gladius* is identical with *Eucope parasitica* Ag. I am unable to decide.

[2]) The absence of nematocysts in the polypes of *Ichthyocodium* seems to point in the same direction.

ment); but how, I am not able to decide. That they as true parasites should feed directly on the tissues of the fish is possible, but seems less probable; neither in *Hydrichthys* nor in *Nudiclava* are the hydrorhizæ sunk into the skin, and the latter appears not to be affected by their presence (the same holds good for the *Scopeli* carrying *Ichthyocodium*); more likely they are messmates or commensals, feeding on leavings from the meals of the fish or perhaps on the excrement of the latter. I may add that I found no contents at all in the gastric cavity of the polypes of *Ichthyocodium* which I have cut in sections.

Explanation of the plates.

List of reference letters.

a = anus.
a_1 = antennule.
a_2 = antenna.
f = furcal appendage.
g = genital segment.
l = chitinous thickening.
m = manubrium of medusa-bud.
md = mandibular palp.
me = medusa-bud.
mp_1 = maxilliped of first pair.
mp_2 = maxilliped of second pair.
mx = maxilla.
o = genital opening.
p = polype.
p_1—p_3 = first to third abdominal (thoracic) foot.
pr = lateral outgrowth from cephalothorax.
r = marginal tentacle of medusa-bud.
si = sipho.

Plate I.

Fig. 1: *Scopelus glacialis* Rhdt. with the combined parasite, composed of the *Sarcotretes scopeli* (without egg-strings) and the *Ichthyocodium sarcotretis*. × c. 2.

— 2: enlarged view of part of the same specimen of *Sarcotretes* (the stalk and proximal part of the swollen external portion) with part of the Hydroid-colony. me_1 = large medusa-bud having lost one of its marginal tentacles.

Fig. 3: one of the largest medusa-buds. Zeiss Comp. Oc. 4, Apochr. 8.
— 4: base of external part of a *Sarcotretes* carrying a young *Ichthyocodium*, consisting of a single polype, still without mouth-opening ("Thor"'s station 124).
— 5: the same part of another *Sarcotretes* with a young Hydroid-colony of polypes of different sizes ("Thor"'s st. 93).
— 6: posterior portion with the stalk and part of the internal portion of a *Sarcotretes* showing a Hydroid-colony with several polypes (only one carrying a tiny medusa-bud, *me*) and its ramified tubes of the basal membrane ("Thor"'s st. 89). Zeiss Oc. 1, Obj. a* 10.
— 7: adult female *Sarcotretes* with egg-strings ("Thor"'s st. 76). Zeiss Oc. 1, Obj. a* 10.
— 8: anterior part of the same, from dorsal side, but somewhat obliquely ("Thor"'s st. 76). Z. Comp. Oc. 4, Apochr. 16.
— 9: posterior end of the same, ventral aspect. * chitinized spot, probably where the copulatory openings have been. × as Fig. 8.
— 10: anterior part of an adult *Sarcotretes* ♀, ventral aspect („Thor"'s st. 89). Enlargement as in Figs. 8 and 9.

Plate II.

Fig. 11: Cyclops-stage (A) of *Sarcotretes scopeli* from left side ("Thor"'s st. 80). Z. Comp. Oc. 4, Apochr. 8.
— 12; the same, dorsal view.
— 13: second pupal stage (C), from right side. ("Thor"'s st. 177). Z. Comp. Oc. 4, Apochr. 16.
— 14: third pupal stage (D), male specimen ("Thor"'s st. 80). Magnif. as Fig. 13.
— 15: fourth pupal stage (E) ("Thor"'s st. 76). Inside the sipho is seen part of the mouth-funnel of the enclosed copulatory stage.
— 16: young female, ca. 4 mm. long; stage inserted into the body wall of the fish ("Thor"'s st. 76). Z. Oc. 1, Obj. a* 10.
— 17: anterior part of the same specimen, from dorsal side. Z. Comp. Oc. 4, Apochr. 16.
— 18: posterior end of the body of the same, lateral view. Enlarg. as the preceding.
— 19: young female, somewhat older than tbe preceding, from right side ("Thor"'s st. 76). Oc. 4, Obj. a* 10.
— 20: anterior part of the same. Z. Comp. Oc. 4, Apochr. 16.
— 21: same part, ventral aspect.
— 22: posterior part of first pupal stage (B), from below (stat. 80). Z. Comp. Oc. 4, Apochr. 8.
— 23: first pair of abdominal (thoracic) feet of third pupal stage (D); same specimen as Fig 14. Z. Comp. Oc. 4, Apochr. 8.
— 24: posterior part of fourth pupal stage (E), ventral aspect (st. 76), same specimen as fig. 15. Inside the left foot of the first pair (p_1) are indicated the outlines of the same foot of the enclosed copulatory stage. Z. Comp. Oc. 4, Apochr. 8.

Fig. 25: right foot of second pair of the same specimen, from below. Enlarged as Figs. 23—24.

— 26: right foot of third pair of the same specimen, from below. As Figs. 23—25.

— 27: *Peroderma bellottii* Rich., ♀ (without egg-strings), inserted into the arterial bulb *b* of the heart of *Scopelus glacialis*; v = ventricle; a = auricle; ar = stem of branchial artery. ("Thor"'s st. 99, 1910). Z. Oc. 1, Obj. a* 10.

The figures 1, 2, 4 and 5 are drawn by H. V. Westergaard, the remaining by the author.

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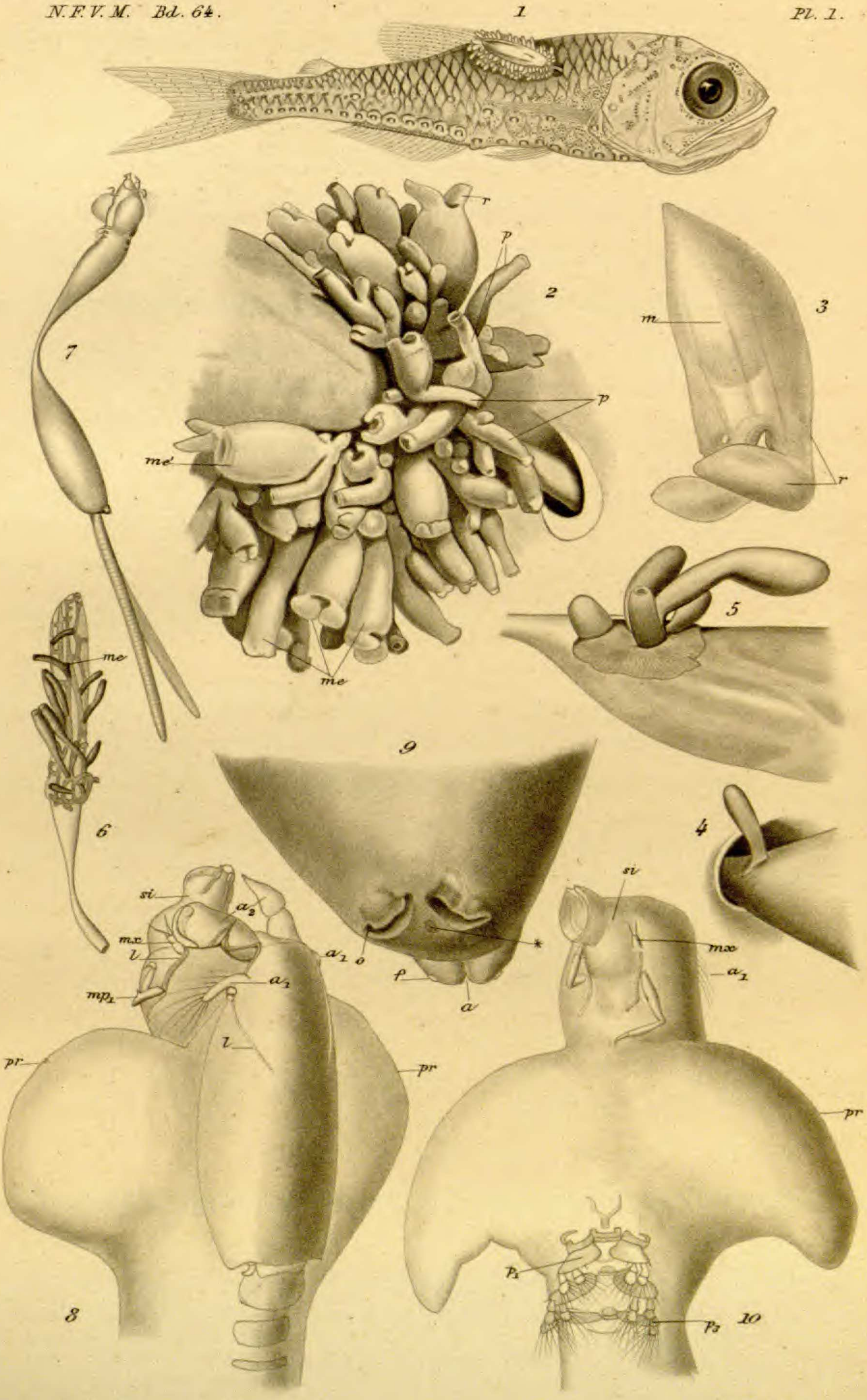

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